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Pharmaceuticals have been recently detected in natural water bodies and could have an impact on the biological activity of natural waters [1]. The increasing use of pharmaceuticals [2] and the unsuitability of the current Waste Water Treatment Plants (WWTPs) to decrease the concentration of these molecules [3,4] are the major reasons for their occurrence in surface waters.

In this work an electro-activated glassy carbon electrode (aGCE) was tested as sensor for the detection of acetaminophen (APAP) in surface water samples. The best measurement conditions for the determination of APAP by Differential Pulse Voltammetry (DPV), assisted by the aGCE, were optimized by means of a Design of Experiment approach. The analytical performance of the electrochemical procedure was than assessed in synthetic solutions and in real samples. The system can detect APAP concentrations higher than 4.4 $\mu g\ L^{-1}$ in untreated river-water samples, and higher than 0.2 $\mu g\ L^{-1}$ in river-water samples that were pre-treated by solid phase extraction. The analytical response had a linear trend with concentration between 5.5 and 33 $\mu g\ L^{-1}$. The electrochemical technique based on DPV with aGCE was then used for the quantification of APAP in river water samples collected in the Turin area (Piedmont region, NW Italy) with the collaboration of ARPA-Piedmont (Agenzia Regionale per la Protezione Ambientale). The results were successfully compared with those obtained by liquid chromatography-mass spectrometry (HPLC-HRMS) to assess the reliability of the electrochemical measures.

The same electrode was then tested as sensor for the detection of the diclofenac. The drug can be easily absorbed on the surface of the activated GCE allowing the revealing of the analyte at very low concentration levels.

[1] B. Halling-Sorensen, S. N. Nielsen, P. F. Lanzky, F. Ingerslev, H. C. Lutzhoft, S. E. Jorgensen, Occurrence, fate and effects of pharmaceutical substances in the environment - a review. Chemosphere 36 (1998) 357-393.

[2] B. Medhi, R.K. Sewal., Ecopharmacovigilance: An issue urgently to be addressed. Indian J. Pharmacol., 44(5) (2012) 547-549.

[3] T. Deblonde, C. Cossu-Leguilleb, P. Hartemanna, Emerging pollutants in wastewater: A review of the literature. Int. J. Hyg. Envir. Heal. 214 (2011) 442-448.

[4] M. La Farré, S. Pérez, L. Kantiani, D. Barceló, Fate and toxicity of emerging pollutants, their metabolites and transformation products in the aquatic environment. Trends Analyt. Chem., 27 (11), (2008), 991-1007.